Mind the Gap: Can We Reverse the Decline in the Pace of Technology Diffusion?

Michael Meurer and *Jim Bessen*

Although the pace of innovation in the American economy has been strong and steady for decades, the diffusion of new technology from firms on the frontier to firms at middling levels of productivity has declined over the past decade or two. We review the economic literature explaining the growing productivity gap and consider law and policy reforms that could reduce the gap. Perhaps the gap is a durable new feature of the ""winner-take-most"" economy; or perhaps law and policy changes have slowed technology transfer, the mobility of knowledge workers, and the success rate of high-tech start-ups. We analyze the social welfare effect of reforms that could speed technological diffusion and focus particular attention on productivity, wage growth, and inequality.

The textile industry, at the heart of the industrial revolution, is a good place to start if one wants to understand how technology is created and deployed to raise productivity and social welfare. As typical of complex technologies, the process of inventing new features in textile machinery was cumulative and stretched over years and decades. Commercializing new machines also took time and often required substantial and risky investment. These observations are familiar to scholars of innovation, but there is more to this story that is not well known.

When new textile plants were built in the nineteenth century, or new machinery was installed, productivity improvements did not always follow. The problem – not all of the important technical knowledge needed to achieve productivity growth was embedded in the new machines and plants. Productivity improvements often depended on the knowledge accumulated by workers and managers about how to best use new machines. When William Gilmour introduced the first successful power loom to America in 1817, he could not get his machinery to work properly. The fault was not in the machinery; it worked fine when a skilled English weaver arrived at the plant and properly adjusted the equipment.

By the end of the nineteenth century, the textile industry had matured and state-of-the-art machinery was available from British manufacturers and installed at mills around the world. Nevertheless, the knowledge of textile workers was still critically important. Mills in the U.S. and Britain were 6.5 times more productive than mills in India or China, even though all the mills had the same equipment. Economists have attributed much of that productivity gap to the skills of the American and British mill workers. Notably, many of the Asian mills at this time featured British managers, master weavers, spinners, and engineers. Apparently, this expatriate staff was not sufficient to overcome the lack of knowledge and experience of the line workers.

The lesson we draw from the nineteenth century textile industry is that persistent invention and innovation in manufacturing processes may not be sufficient for an industry to achieve broad gains in productivity. It may be necessary to combine improved machinery with complementary technical knowledge held by the workers who use the new technology. South and East Asian textile mills eventually achieved productivity levels comparable to those in the West. Practices related to the organization of the workplace and training and experience of workers sometimes diffuse slowly and thereby slow the spread of productivity gains.

There is evidence that today the pace of technology diffusion in the U.S. and other major economies is declining. It is difficult to generalize about the causes. In some industries new innovations are shared quickly and widely among competing firms, while the opposite is true in other industries. In this Article, much of our attention is directed to the diffusion of technical knowledge that is held by workers or embodied in software rather embodied in equipment. Our focus leads us to wonder whether impediments to the movement of knowledge workers, or diffusion of software innovations is a major cause of the slowdown of productivity growth, and whether the pace of diffusion can be increased by law and policy changes that encourage more rapid diffusion of technology.

The Article contains three sections. The first section describes the productivity slowdown being experienced by major economies. In that section we attribute much of the slowdown to slower diffusion of technology that has created a growing productivity gap between firms at the technology frontier and others. Faster diffusion could improve average productivity, reduce inequality, and encourage wage growth for average workers. The second section explores possible causes of sluggish diffusion. Growing dependence of new technology on custom software creates one barrier to diffusion. Custom software may create a barrier because of the economies of scale and scope often associated with software development. Furthermore, as illustrated by the textile industry example, diffusion may be limited unless firms can hire workers with appropriate skills or until their current workers have an opportunity to learn how to use a new technology. Widespread use of covenants-not-to-compete and other anti-competitive tactics appear to be disrupting the market for knowledge workers. Finally, we explore whether in some cases slower diffusion is just the social cost that must be incurred in connection with socially desirable patent and copyright based incentives needed to encourage innovation. The third section considers policy options that might improve diffusion by improving the mobility of knowledge workers, or increasing the sharing and licensing of technology by adjusting enforcement of competition law and intellectual property law."